

**Before the  
FEDERAL COMMUNICATIONS COMMISSION  
Washington, D.C. 20554  
11 August 2003**

In the Matter of	)	
Inquiry Regarding Carrier Current Technologies	)	
Systems, including Broadband over	)	ET Docket No. 03-104
Power Line Systems	)	

REPLY COMMENTS OF CORTLAND E. RICHMOND, Jr.  
to  
Comments of CURRENT TECHNOLOGIES, LLC, dated July 7, 2003

These are Reply Comments of Cortland E. Richmond, Jr., to Comments of Current Technologies, LLC in this document referred to as Current Technologies, in the matter above, dated 7 July 2003.

The writer has been involved in EMC and EMI engineering since 1983, spent 21 years in the United States Army working with airborne and ground communications equipment, and has been an Amateur Radio operator since 1958.

These replies take the form of excerpts from Current Technologies' original comment, noted as Comment, followed by reply remarks, noted as Reply. A Roman numeral annotates each Comment and Reply. Replies commence below.

**I**

Comment:

**1. Adopt BPL rules quickly.** Timeliness is critical. Consumers will benefit most if the price cuts from added competition occur promptly. Congress specifically instructed the Commission to adopt measures promoting broadband competition on a "timely basis."<sup>20</sup> And prompt regulation is essential for access to capital markets. The regulatory uncertainty of a drawn-out proceeding may limit the ability of BPL service providers and technology developers to raise capital. And, once the broadband market is saturated, all broadband competitors will be significantly inhibited in raising capital to deploy their networks and market their services. There is a limited time window during which Commission action can have disproportionately beneficial effects in promoting broadband competition.

**Reply:**

Current Technologies here asks for adoption of regulations which are not required to allow it to operate, but which will increase difficulties for those who are at present primary users of the radio spectrum it wishes to employ. This has all the earmarks of a *coup de main*, and one the Commission would do well to resist.

## II

Comment:

***Use real-world interference analyses.*** We are starting with a noisy radio-frequency environment, and the Commission must take that into account in assessing the impact of BPL. No BPL regulation can "re-quiet" the environment back to the pristine state that some commenters prefer. Even before the comment due date, this docket showed over 1500 filings, many very similar, most grossly overstating the interference potential of BPL. These are written with little or no understanding of BPL technology. Current Technologies agrees with the need to prevent *added* real-world harmful interference to licensed services. We urge the Commission to carry out its analyses using models and parameters that accurately reflect both the likely emissions from BPL and the interference susceptibility of other services under actual operating conditions.

Reply:

Current Technologies here does what it accuses its detractors of doing, only in the other direction. Present levels of interference rarely rise to the levels permitted by Part 15, and when they do, rarely occupy the wide swaths of spectrum BPL wishes to use. To draw a parallel; we are in the same position now with regard to BPL as we were in 1979 or 1980 with respect to personal computers. Then, existing interference limits, at one time adequate to protect most radio users, proved insufficient in the face of widespread deployment of a new, interfering technology. So too, Part 15, as it presently exists, is inadequate to protect existing services – services the Commission is obliged to protect – from abuse of a new technology.

## III

Comment:

***3. Minimize technical regulation.*** The Commission has often said it prefers technology neutral regulation. Here, the Commission should establish the emissions limits and other criteria (if any) needed to prevent actual, additional, harmful interference to licensed services, but then let BPL manufacturers and providers decide how best to achieve those limits. Regulatory flexibility will let this newly emerging industry develop and adapt as needed to meet consumers' changing demands.

Reply:

What limits the Commission adopts will best serve existing Services and BPL providers if it preempts harmful interference from the onset, and does not require the Commission to later engage in thousands of enforcement actions responding to complaints of harmful interference from all across the country.

#### IV

Comment:

**4. Minimize non-technical regulation.** BPL is a unique offering. There is no *a priori* reason to regulate it like any other service. Moreover, BPL is a nascent technology having few U.S. commercial customers at this writing, and no widely accepted technology standards. Yet it must compete with mature, extensively deployed services. Applying unnecessary rules to BPL in the interest of achieving some ill-defined parity with other services could cripple instead of catalyzing its viability as a broadband competitor. The Commission should regulate BPL no more than necessary to prevent radio interference.

Reply:

BPL is unique only in bypassing transmission media presently offered by others and subject to Commission regulations requiring economically equitable sharing. It is not a unique service. It even has the potential to monopolize access which led the Commission to impose sharing requirements to begin with. In order to prevent unfair and damaging competition, with the potential for an actual reduction in broadband choices, BPL should be granted no better treatment than others.

#### V

Comment:

**5. Minimize testing costs and delays.** Our experience at measuring emissions from BPL-equipped homes shows it to be a difficult task, due primarily to two factors. One is changing ambient noise, because BPL signals are typically close to the measurable threshold. The other is the highly variable nature of electric distribution network configurations, including the home electrical environment. To help alleviate these problems, the Commission should allow manufacturers to use multiple, streamlined, laboratory-based measurement procedures where analysis can show these to reflect actual interference potential. But the Commission should not mandate test procedures that introduce new uncertainties as to the likely interference from any particular device. And the Commission should always retain the option of full-scale, on-site testing at representative installations as the most direct way of assessing the impact of BPL on the radio-frequency environment.

Reply:

It is difficult from this Comment to see what difficulty was encountered. Several possibilities suggest themselves. Home power wiring has far better HF balance and less common-mode conversion than medium and high voltage wiring, which even if balanced, is spaced so widely that substantial radiation may be expected. Tests at 10 or even 3 meters from home wiring will therefore not reflect the reality of a resident trying to hear something on a table or portable radio. Quasi-peak detection further reduces the levels seen, and unduly, since victim receivers are sensitive also to peaks. Was testing carried out with a fully running system? One cannot expect to offer high-speed systems but test at a low speeds. Deliberate and desired signals with relatively constant carriers will measure much higher than a heavily modulated and broadband signal. (This is one of the pitfalls of making Quasi-Peak measurements on an Open Air Test Site [OATS].) The writer agrees measurements should duplicate actual interference potential. And they might, if conducted with a rod antenna at one meter from BPL-carrying wires, similar to what a residential radio user must do. On-site testing, as onerous as it is, seems the only way to be sure what we are getting.

## VI

Comment:

(a) *POINT-SOURCE EMISSIONS*. Some parties to this proceeding assume the entire length of a BPL-equipped power line emits radio-frequency noise, and hence evoke the frightening image of a miles-long transmitting antenna. That is simply wrong. BPL emissions come almost entirely from a short segment of line immediately adjacent to where the BPL device is attached. From a few meters away, the signal closely resembles that from a point source. In that respect it is much like other common sources of radio-frequency noise, such as computers and household appliances. BPL uses the wires only as a conducted transmission medium, and has no more inherent propensity for causing interference than does any other unintentional digital emitter.

Reply:

Current Technologies and others propose to occupy spectrum whose wavelength is up to 150 meters. Radiation from the first wavelength of wire accounting for most of the power lost to radiation, it is to be expected that emissions will then be a problem for up to 500 feet away from its equipment ? and in either direction along the line. Moreover, the experience of European users has been that repeaters were required to adequately extend service, each one of which repeats, remotely the emissions Current Technologies tells us are only local. If repeaters are spaced some 2,000 feet from each other, interference may be expected along most of the powerline right-of-way.

## VII

Comment:

(footnote) 23 Even the Commission incorrectly characterizes BPL signals as radiating from the wires as though they were antennas. *E.g.* Notice at paras. 21, 23.

Reply:

The Commission is correct.

## VIII

Comment:

*(b) NO AGGREGATION.* Some parties likewise assume that noise signals from multiple BPL devices will aggregate harmfully. One or two BPL devices may not be a problem, they say, but additive emissions from tens of thousands over a small area will raise the noise floor. That, too, is incorrect. An Access BPL system has one medium-voltage device at each transformer, but only one of those on a BPL distribution leg ? typically many blocks long ? can transmit at a time. Low-voltage devices, including user modems, may be closer together, but the HomePlug standard allows only one such device served by a given transformer to transmit at a time. The total emissions from all the houses served by one transformer add up to only one modem. And when the signals from devices at one transformer reach the next transformer, they are too attenuated to add significantly. There is no harmful aggregation.

Reply:

It is not necessary for emissions to be coherent with each other to add in a victim device. They might add as the square root of the sum of their squares, perhaps, but they will still add. And ten emitters, each taking up its own time slot on the powerline antenna, **can** create more harmful interference than one. By analogy, the occasional spark from a passing automobile does not much disrupt communications. Having it park near ones antenna is quite another matter. Field tests by the ARRL have confirmed higher levels of interference on certain BPL systems, perhaps Current Technologies', when more devices were in active use than when a system was occasionally polling each device.

## IX

Comment:

*(c) MINIMAL EFFECT OF WIDE BANDWIDTH.* Some parties claim that BPL devices are more interfering than other unintentional emitters, such as computers or appliances, because they emit over a wide bandwidth. But emissions outside a victim receiver's passband have no significant effect on interference to that receiver. For example, a two-way radio with a 12.5 kHz receiver bandwidth is not affected by an interference source at frequencies outside that bandwidth. The overall bandwidth of a BPL system has no bearing on its propensity to interfere with any given receiver. In principle, perhaps, the higher bandwidth might be said to impact more receivers from a given BPL system. But it does not happen that way. Because BPL emissions are local to a point source and do not aggregate, even a wide bandwidth has little effect on a system's potential for interference to the overall population of receivers.

Reply:

To rephrase Current Technologies' argument, it is that BPL does not interfere with a single receiver, but with **many** receivers. This is not better. As to aggregation, that is again a matter of the wavelengths concerned and system loading. A higher PRF due to multiple interrogations is not, technically, aggregated, but it is aggravated.

## X

### Comment:

We urge the Commission to identify and adopt emissions limits aimed at preventing actual BPL interference in the context of the existing radio-frequency environment. So far as possible, the rules should be framed to promote innovation and competition. There should be no regulation of BPL except that aimed at real risks of significant interference. In particular, the Commission should recognize that a BPL device mounted high on a pole or inside a metal curbside enclosure can safely be allowed somewhat higher emissions levels than a device used inside a residence.

### Reply:

The existing rules have fostered innovation and competition. They have also been shown by measurement to permit interference at levels proven harmful. If the Commission should ☐g adopt emissions limits aimed at preventing actual BPL interference in the context of the existing radio-frequency environment, ☐h limits, especially in the rural l environments for which BPL is said to be best suited, would have to be substantially lowered. This result might not be what Commenter wishes to see happen.

## XI

### Comment:

Rules to limit interference should consist of a field strength specification at a particular distance. Manufacturers and providers should have full flexibility in how they achieve compliance.

### Reply:

Since manufacturers of BPL equipment cannot predict or control the radiating characteristics of lines to which it is attached, levels must be set to prevent harmful interference. This writer recommends a distance of one meter from Home-BPL lines, using a peak detector. The Commission is already obliged to prevent harmful interference, and manufacturers and providers have sufficient flexibility now both to comply with Part 15, and respond to instances of harmful interference.

However, the Commission from time to time sends Warning Letters to utility power companies whose systems, for one reason or another, already generate harmful radio interference, and who ignore their duty to correct it. This being the case, the writer suggests that those companies cannot be expect to show more diligence with respect to BPL, and the burden of compliance must therefore rest on manufacturers.

## XII

Comment:

Field strength specifications should allow higher emissions in parts of the spectrum where they do not threaten interference.

Reply:

One cannot know in advance which frequencies will be used at any given time, in any given area, by services now operating between 1.8 – 88 MHz. Therefore no regulatory provision can reasonably be made for spectrum which may from moment to moment or even hour to hour seem unused at a particular location. And not every user who must be protected, transmits.

## XIII

Comment:

Conducted emissions should not be regulated at all, outside the AM broadcast band, because they have no direct bearing on interference. Even an implementation that results in high conducted emissions should be unobjectionable so long as the radiated emissions stay within limits.

Reply:

Radiated emissions must indeed stay within limits. However, adherence to those limits cannot be assured unless limits are also placed on current carried by radiating conductors. Manufacturers cannot know to what configuration of conductors providers will attach their equipment, and must therefore design and test as if providers were as dismissive of EMI as the conduct at XI suggests.

## XIV

Comment:

Because Access BPL devices are either mounted high on a pole or enclosed within a metal curb-side housing, they should be permitted at least Class A emissions in both commercial and residential areas.<sup>27</sup> (At 30-88 MHz, where many BPL systems will operate, Class A is only 27 *billionths* of a watt) As an extra precaution, the Commission may wish to hold Access BPL to Class B in the TV and FM bands in residential areas.

Reply:

Current Technologies suggests that, because of the low (sounding) power involved, Class A limits are adequate to protect communications users. However, in the range Current Technologies mentions, 30-88 MHz, communications systems typically provide full quieting and operate at received signal levels on the order of 1 microvolt at the receiver, or only  $2 \times 10^{-14}$  watts. The Class A limit, at what Current Technologies says\*\* is  $2.7 \times 10^{-8}$  watts, far outweighs it, and Class B, almost 10 dB lower, is still far from adequate to protect Services of the same typical signal levels, though it has up to now proven adequate, when outdoor antennas were used, for the much higher signal levels delivered to television broadcast receivers. However, those antennas (where permitted) have not usually been pointed at the sources of interference, and complaints may be expected from some over-the-air television watchers.

\*\*The antenna factor of a dipole being unity just above 30MHz, the  $90 \mu\text{V/m}$  Class A limit there produces  $90 \mu\text{V}$  at the receiver (ignoring feedline loss), for a power of  $(90 \times 10^{-6})^2 / 50$  ohms watts, or .162 nanowatts (billionths of a watt). This still far exceeds the desired signal. Perhaps Current Technologies refers to the power of interference it radiates.

## XV

Comment:

Because current In-House BPL devices transmit one at a time, there is no basis for setting their limits below Class B, which any receiver should be expected to tolerate.

Reply:

A drum only produces one beat at a time, but let one's neighbors form a drum quintet, and limits become less theoretical. In any case, Current Technologies here errs in assuming that adherence to Part 15 exempts one from the duty not to cause harmful interference. It does not, and that interference will result, is adequately demonstrated by Current Technologies' own numbers. Not content to imply that interference orders of magnitude stronger than desired signals should be permitted, Current Technologies also asserts that existing services have no business trying to receive weaker signals than Part 15, which any receiver should be expected to tolerate. Current Technologies here seems trying to dictate what equipment existing services may use. Will Current Technologies and other BPL manufacturers and providers pay for replacing it with the equipment they prescribe? The cost could be ruinous to many government and business users, among them small businesses. Fortunately, there is precedent for such reimbursement. Based on the Commission's ULS database, and given the number of users of this spectrum in California alone, the cost of that reimbursement would run into many billions of dollars.

## XVI

Comment:

The Commission should not draw any regulatory distinction between Access BPL and In-House BPL. These terms distinguish components having different purposes to the end user; but that has no direct bearing on interference potential. As explained above, for each transformer and the cluster of homes that it serves, an Access and an In-House system together entail only two devices transmitting at any moment. They carry out similar communications functions and can be expected to have similar radio-frequency characteristics. Accordingly, they should be subject to the same rules. Moreover, some providers may wish to offer integrated systems that deliver both Access and In-House functions, and may want to install devices that participate in both. That would be difficult under disparate rules.

Reply:

Access BPL may place current on residential wiring, and In-House BPL may radiate outside the home. This fact suggests that they should indeed be treated the same. In particular, test techniques and emission limits should be so crafted that radiated interference is measured at distances appropriate to the proximity of residents' victim radios, and limits set to allow them unfettered use of their property. The writer is not an attorney, but it seems possible that action by the Commission which in its end effect prevents use of that property, viz: privately owned radios, might be considered a government taking requiring government reimbursement. And while consumers do not comprise the same economic burden per capita that low-band-VHF users do, there are many, many more of them.



## XVII

### Comment:

Current Technologies has worked extensively with FCC engineers on the problems of measuring emissions from BPL-equipped homes. Those problems can be significant. Because of the very low signal levels involved, it is difficult even to confirm that the readings obtained are due to BPL. When on-site measurements are taken outdoors at an appropriate distance from the house or pole-mounted device under test, changing interference from other sources – typically licensed transmitters operating at power levels far higher than BPL – routinely contaminates the results.

Accordingly, in addition to the option of on-site testing, Current Technologies would welcome standardized, reproducible test configurations that expedite emissions testing of BPL devices. Unfortunately, the present early stage of BPL development has not yet provided the industry with enough practical experience, under a broad enough range of operating conditions, to arrive at such test configurations. Therefore we ask the Commission to collaborate with the BPL industry to develop standardized, reasonably representative, reproducible, laboratory-based configurations that can be constructed in a lab for testing both In-House and Access systems, and that do not arbitrarily reduce permissible BPL power levels below those to be set out in the emissions limits. These models do not have to give results identical to any particular real house, but need only be reasonably representative. Collaboration – and a fully transparent development process – are important to ensure the outcomes neither improperly discriminate among alternative BPL implementations nor disadvantage the BPL industry as a whole.

### Reply:

See V, above. The writer has suggested some standardized radiating structure in comments. Unfortunately, the interference levels Current Technologies seems to think appropriate so far exceed signals now used by services their technology will affect, that calling for such a standard seems merely a gesture. Yes, testing is difficult to plan for with a myriad different installations. That is why one must plan for the worst of them.

It is not that BPL would be disadvantaged by existing regulations. It is rather that BPL could disadvantage, to the point of displacing, almost every present user of the spectrum under discussion. One is obliged, in the course of business, banking, say, to remove obstacles in the way of those whose disabilities prevent them overcoming what the rest of us take for granted. One is not, however, required to provide the same consideration for a someone who enters the bank to, without consent, withdraw other people's money.

## XVIII

Comment:

(footnote) 31 Current Technologies notes that early development work may show it is too early for the industry to agree on such standards, in which case the Commission should defer the matter to a more propitious time. The development of testing models should not become a precondition to adoption of BPL technical rules.

Reply:

The development of test models should indeed be a precondition to adoption of BPL technical rules; they can hardly be adopted without such. More, the development of an industry standard no less rigorous than the National Electrical Code seems to this writer necessary to insure uniformity of treatment of the multitudinous vendors and providers trying to make money from BPL. Anything less would impose by omission handicaps on some not imposed on the others.

Too, the variety of different emissions and technologies presently under test does not readily admit of one single method of measurement, let alone fixture or site standards. For example, where one vendor, such as Current Technologies, speaks of its own technology's freedom from aggregation, others, with different technologies can make no such claim. Until the industry among its members can come to some agreement on parameters, it is premature for the Commission to allow widespread deployment to go forward. It is also economically risky to proceed in a standards-free environment when a later decision or unpredictable market forces may make obsolete an investment of many millions of dollars.

## XIX

Comment:

*Equipment authorization.* BPL devices marketed for mounting on a pole or enclosure in a curbside housing should be subject only to verification, as they are now. There is no need for a change. Pole- and enclosure-mounted BPL equipment must always be professionally installed, and offers little potential for interference. Equipment that plugs into outlets or otherwise attaches to the 240/120 service and house wiring should be subject either to verification or Declaration of Conformity. There is no precedent for requiring certification. Indeed, the Commission does not subject any unintentional radiators to certification (except radar detectors, which the Commission found to pose a specific interference threat).

Reply:

Given the very high levels of interference Current Technologies expects to generate, there is every reason to hold BPL equipment to the most stringent oversight, and little reason to relax it. Moreover, for RFI, anyway, BPL is indeed unprecedented.

XX

Comment:

The American public needs BPL, both to provide ubiquitous, low-cost broadband access where it is not otherwise available, and also to provide meaningful competition to existing broadband service platforms. Field experience shows the technology meets customers' needs, is cost-effective, and is ready to deploy more widely in the coming months. The Commission should move expeditiously to issue a Notice of Proposed Rulemaking, in which it should propose the minimum regulation necessary to prevent interference.

Reply:

This writer believes the preponderance of evidence, and even Current Technologies' own reasoning, not least its unabashed desire to dictate the property rights of radio and communications system owners, argue that the minimum regulation needed is not, as Current Technologies and others desire, less – but **more**. Competition already exists among broadband providers and will increase in a healthy manner as the economy recovers. BPL would not only hobble that competition, but destroy radio services on which the nation relies, and to whose preservation it is committed by treaty. Consequently I urge the Commission to disregard the rosy statements made by Current Technologies. Those roses have too many thorns.

--0--

The writer desiring that the Commission examine Current Technologies' comments with the above in mind, these replies are respectfully submitted,

Cortland E. Richmond, Jr., KA5S

11 August 2003